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Editorial

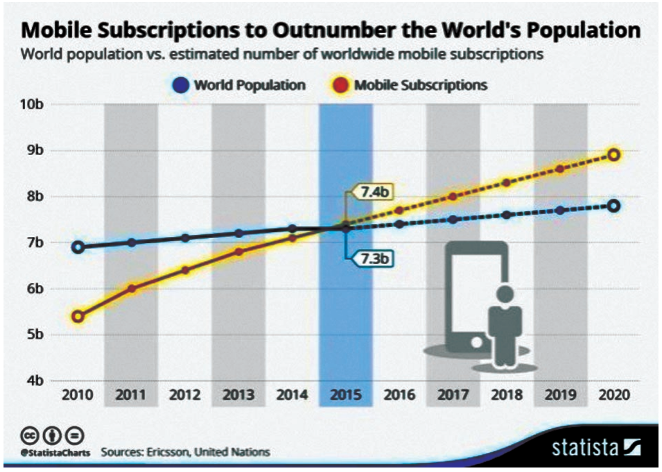
MOBILE PHONE AND TOWER RADIATION: A CHALLENGE TO ALL LIVING ENTITIES

Use of mobile phone is increasing at a great speed every day. It is now becoming like a body part to many individuals, especially of younger generations. Cellular phone technology has revolutionized the global telecommunication scenario with exponential increase in cell phones and mobile towers. As it is also a very good scope for business, majority of mobile phone towers are mounted near the residential area on the residential and office buildings to provide good coverage to the users. These towers continuously transmitting radiation on the exposing residents in proximity to 10^4 to 10^7 times stronger signal (Ghildiyal *et al.* 2014). In addition to the continuous radiation from mobile towers and mobile phones or wireless phones, many other such radiations - like radiations from computers, laptops, TV towers, FM and AM broadcasting towers, microwave ovens etc. are encountered everyday by us. We are exposed to all these radiations, which are additive in nature (Ghildiyal *et al.* 2014).

Population growth and increase in mobile phone use

As per the prediction of United Nations department of economic and social affairs (2017), world's present population is about 7.2 billion. World Economic Forum mentioned that the mobile industry is now in explosive growth worldwide with an ever-growing demand for data traffic. In the year 2017, the mobile phone users are in 4.77 billion and expected to reach about 5 billion in 2019. As per the available data, the number of mobile subscribers has already exceeded the number of world population (Statista 2013-2019)! So, many persons are accustomed with use of more than one mobile phone connection.

In India, the telephone subscribers using wireless form of communication in urban area is 63.27% and in rural area 33.20% of population as per the report of Telephone Regulatory Authority of India (TRAI) (Saravanamuttu *et al.* 2016).



Source: Ericsson, United Nations (Statista Chart).

Living in the sea of electromagnetic radiations

Flora and fauna including human beings are flooded with massive amounts of powerful wireless Electromagnetic Radiations (EMR). We are now exposed to hundred million times more EMR than our grandparents were. Cell Towers emit high-frequency microwaves (about 1900 MHz) and spread in biosphere. Both base stations (BS) and the mobile phones (MP) regularly waste 70% of the energy. Health hazards by EMR may be thermal and non-thermal. The thermal effect is like cooking in microwave oven, but a lot of damages done by the non thermal effects (Kour *et al.* 2016).

Radiation Frequencies

Mobile Phone Tower's antennas transmit in the frequency range of 869 - 894 MHz (CDMA), 935 - 960 MHz (GSM 900) and 1810 – 1880 MHz (GSM 1800) in Second Generation (2G), 2110 – 2170 MHz in 3G, 2300 - 2400 MHz in 4G, 2400 - 2500 MHz in Wi-Fi, Blue Tooth and 3400 - 3600 MHz in 5G services. Living entities staying within 10 meters from Mobile Towers receiving 10 thousand to 1 lakh times stronger signal (radiation) than the requirement (Akbal *et al.* 2012). People living within 50 meters of towers having more health problems than those living outside (Pachuau and Pachuau 2014). So, closer to people near the towers, greater the danger. Millions of people residing within high radiation zones in our country and our environment is highly exposed to electromagnetic waves by many sources, including mobile devices (Akbal *et al.* 2012).

Time limit for mobile phone use

The Specific Absorption Rate (SAR) value is the radiation absorbed by living organisms including people, measured in units of watts per kg (w/kg) of tissue. The limit is 1.6W/Kg for 6 minutes per day usage and the margin of safety 3 - 4 times. So, more than 18 - 24 minutes per day use is not safe. Millions of people are not aware of it and using mobile phones throughout almost the entire non-sleeping period daily without realizing its associated health problems (Kumar 2010).

Reports from India

A study on the quantification of electromagnetic field (EMF) radiation from mobile towers and their health impacts on human beings have been carried out in Kota city of Rajasthan. It has been noticed that EMF radiation from almost 50% of the mobile towers installed in Kota city is beyond the permissible limits prescribed by the DoT, Govt. of India (Vijay and Choudhary 2017).

Effects on human

The Food and Drug Administration (FDA), Indian Council of Medical Research (ICMR) and many other research workers reported that radiation from both mobile phone and towers causes adverse health effects. After absorption of electromagnetic radiation, the body is heated internally and causing damage to various organs. High exposure can also instigate Alzheimer’s disease, Morgellon’s disease, Tinnitus, bone weakening; sleep disorders, neurodegenerative diseases and even high cancer risk (Ghildiyal *et al.* 2014).

Several studies reported irregular heart beat and pulse rate when mobile phones are placed on chest (closer to heart) and on ear (closer to brain) for a specific time (Mitra *et al.* 2014). Significant effects were observed on heart rate and blood pressure due to exposure of mobile phone radiation (Aghav *et al.* 2018). It can interfere normal works of implanted Cardiac Pacemakers, implantable Cardiovascular Defibrillators (ICDs) and Impulse Generators (Ghoshdostidar *et al.* 2011). Epidemiological studies among MP radiation exposed people revealed sleeping disturbances, discomfort, headache, irritability, appetite loss, nausea, muscle spasms, depression, nervousness, agitation, concentration difficulties, visual disorders, changing blood pressure, cardio-vascular problems etc. (Kumar 2010, Jain and Bansal 2017). Occupational health hazards found much more in Telecom workers working closely with equipments for testing, maintenance, installation, etc. with much greater exposure (Soju *et al.* 2015).

How it works?

As human body consists of 70% liquid, it absorbs electromagnetic radiation, when it is exposed. It is similar to that of cooking in the microwave oven, where the water in the food content is heated first. Microwave absorption effect is much more significant by the body parts, which contain more fluid (water, blood etc.), like the brain which consists of about 90% water. Effect is more noticeable where the movement of the fluid of the organs is less. So, the fluids of eyes, brain, heart, abdomen, joints etc. are affected much more. As human height is much greater than the wavelength of the cell tower transmitting frequencies, so multiple resonances in the body happens which creates localized heating inside the body. This results in boils, drying up of the fluids around eyes, brain, heart, abdomen, joints etc. (Sharma and Lamba 2017).

Electromagnetic radiations are having various other effects also, including causing deterioration in large molecules in cell, imbalance in ionic equilibrium, damaging of cellular components such as proteins, lipids and DNA (Elfide 2017).

Effect on blood-brain barrier leading to cancer

The blood-brain barrier selectively allows nutrients to pass from the blood to the brain, but keeps toxic substances out. As per available reports, a single two-hour continuous exposure to a cell phone just once during lifetime may permanently damage the blood-brain barrier. Due to this, besides increase in brain tumour and acoustic neuroma, there is also increased risk of several other types of cancers following prolonged exposure to mobile phone/ tower radiation continuously. Among these, salivary gland tumours, tumours at the eyes and facial nerve, lymphoma, skin, blood, testicular and breast cancer etc are important (Sharma and Lamba 2017).

Causing hearing loss and ear tumour

Temperature of ear lobes increases by approximately 10°C when mobile phones are used for 20 minutes continuously and prolonged use of it can cause auditory disturbance in terms of hearing loss (Sharma *et al.* 2016).

The radiation emitted by mobile phones may damage the delicate parts of the inner ear. Persons using cell phones 2-3 hours every day are inviting the risk of partial deafness over 3 to 5 years. The problem generally starts with a pain in the ear that gradually develops into tinnitus or a ringing sensation. That may finally lead to hearing loss and / or ear tumour (Sharma and Lamba 2017).

Causing problems of eyes

Frequent use of mobile phones can also damage the visual system in different ways and may also cause uveal melanoma *i.e.* tumour of the eye. Increase in temperature due to the effect of electro-magnetic radiation close to

the eye lens may result in lens opacities and thus increase the risk of developing cataracts. Prolonged exposure may lead to both macroscopic and microscopic damage to the eye lens and this damage seems to accumulate over time and may not heal afterwards (Sharma and Lamba 2017).

Causing irreversible infertility

In one report**,** the American Society for Reproductive Medicine stated that decrease in semen quality by affecting the sperm count and motility, viability and normal morphology of the sperm is related to the duration of cell phone use.

In sperm count, it appears that 30% sperm decrease in number among intensive mobile phone users. The physical damage of sperms is another effect. Cell phone radiation can cause breaks in DNA of sperm cells and cause cancer through that mutation. Damage to sperm DNA is dangerous as it can pass such genetic changes to subsequent generations (Sharma and Lamba 2017).

Effects on children and pregnant women

National Radiological Protection Board (NRPB) mentioned that mobile phone radiation affects children more than adults due to smaller and thinner skull, soft skin, smaller brain size, more elastic ears, lower blood cell volume, greater conductivity of nerve cells, higher cell division rate, more susceptibility to genetic damage, more radiation penetration and for more in longer life time exposure. Children may suffer from disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability in the shorter period exposures due to use of mobile phones. In longer period exposures, the hazards includes depressive syndrome, degeneration of the nervous structures of the brain etc. (Kumar 2010).

Electromagnetic radiations can damage the placental barrier of pregnant woman, which protect fetus in the mother's womb (Sharma and Lamba 2017). It may cause early spontaneous abortions due to effect on fetal development (Mahmoudabadi *et al.* 2015). More use of mobile phones during pregnancy in women may give birth of child with behavioral problems (Sharma and Lamba 2017).

Effects on animals

Animals staying near mobile towers are prone to various dangers including still births, spontaneous abortions, birth deformities, behavioural problems and declining overall health status (Vijoy *et al.* 2015). It may be due to changes in intracellular ionic concentration, cellular proliferation, genotoxic effects, interferences with immune system, effects on stress hormones, reproductive, nervous and circulatory system (Rafiqi *et al.* 2016). Numerous studies have been pointed mobile phone towers as a potential cause of health hazards and decline of animal populations including free-tailed bats (*Tadarida teniotis*) in bat colony (Rafiqi *et al.* 2016).

Effects on birds

Millions of migratory birds die each year from collisions with telecom masts. Ministry of Environment and Forests has ordered further study on the impact of EMR from MP towers on wildlife birds (The Hindu 2012). Birds when exposed to any electromagnetic field, they lose the power of orientation, natural navigation and may fly at any direction. Pigeons, sparrows, swan and others may be affected due to interference from the "unseen enemy", the mobile phone masts (Vijoy *et al.* 2015). It is rare to notice that birds like sparrow, pigeon etc. staying or flying near the MP towers (Vijoy *et al.* 2015, Kaur 2016). The radiation absorption is more in birds than human or animal due to more body surface area to body weight ratio. Since fluid content is small due to less weight, it gets heated up very fast and the magnetic field affects their navigational skills (Soju *et al.* 2015, Rafiqi *et al.* 2016). Vijoy *et al.* (2015) reported that electromagnetic pollution may be possible cause for decline of amphibian populations with some deformation.

Effects on bees and insects

Bees are important to pollinate about 90 commercial agricultural crops worldwide. Scientists warn that the steady decline in bees and other pollinators could trigger more crisis in future than global warming. Electromagnetic radiation affecting the life cycle of honey-bees may cause pollination disturbance. It affects navigation, reproduction, honey production ability and disruption of biological clocks (El Halabi *et al.* 2014). Several workers reported the sharp declining honey bee populations *i,e* Colony Collapse Disorder (CCD) with potential health hazards due to prolong mobile phone tower radiation (Taye *et al.* 2017).

Insects are the key species of ecosystem and found very sensitive to electromagnetic radiations. Studies revealed sharp decrease in population of ants, beetles and other insects close to MP towers. Cammaerts and Johansson (2014) reported that 900 MHz radiation have some impact on nervous system of exposed ants, effects on their physiology, social behavior, orientation and navigation.

Effects on plants

Electromagnetic radiation emitted from MP towers

may affect plants, vegetables, crops etc. (Vijoy *et al.* 2015). A study found that the production of betel nuts and coconuts have been decreased after the installation of mobile tower (Debnath and Bora 2015).

Parihar (2014) reported that electromagnetic radiations from mobile phones and towers can interfere the morphological and biochemical process, growth and nodule formation in the plants. It also affects vegetables and crops in its vicinity, inhibit germination and growth of roots etc. Top of the trees tend to dry up when directly face the MP tower antennas (Sathishkumar *et al.* 2017). Trees located around 50 meters of Mobile towers look sad, feeble, dried tops, slow growth with illness (Debnath and Bora 2015).

Role of WHO

World Health Organization (WHO)'s International Agency for Research on Cancer (IARC) in the year 2011, has classified electromagnetic radiation from wi-fi, mobile phone and towers as category 2(B), *i,e* 'possibly carcinogenic to human'(Hardell 2017). Dariusz Leszczynski, a scientist of IARC expert committee, mentioned that long term average of 30 minutes daily radiation exposure, increases the risk of brain tumour and cancer. WHO again launched a draft in the year 2014, where dismissed the adverse health hazards by radiation, mentioning a proposal for re-evaluation of exposure effects to the people and environment (Hardell 2017). As no conclusive evidence of carcinogenesis was finalized by mobile phone and towers exposure, a long-term exhaustive research study is perhaps required to understand actual effects worldwide.

Guideline to install mobile tower

Different countries like USA, Canada, New Zealand, Belgium, Italy etc. have issued mobile phone and towers exposure standard. In India, MP towers are permitted to emit at 0.45 watts per square meter at 900 MHz, less than international standard. Recently, India Govt. has decided to limit one-tenth of the existing level of base station emissions. Ministry of Environment and Forests engaged an expert group to study the possible impacts of communication towers on wildlife including birds and bees. In their report, many recommendations are forwarded by the members to reduce EM radiation (http://www.moef.nic.in). Many international guidelines published and adopted by many countries, but guidelines of ICNIRP (International Commission for Protection against Non-Ionizing Radiation) are accepted most worldwide (Non-ionizing radiation protection standards and policies 2010).

Rules and regulations

For a long time the Government is forming new rules and regulations to protect health of its citizens. The ICNIRP is an international commission, whose activities include determining exposure limits for EM fields used by devices such as mobile phone. In India, Department of Telecommunication has ordered the mobile phone companies to follow all the guidelines of ICNIRP and as per the Environment (Protection) Act, 1986 the rules includes the following basic points:

1. Cell phone towers should be installed far from the public place, residential, agricultural, school, hospital areas etc.
2. More number of mobile phone towers along with less transmission power facilities are to be provided.
3. In multiple transmission sites at specific locality should sharing of a common tower infrastructure, to be coordinated through any nodal agency.
4. Safe distance between towers and residences to be maintained with regular monitoring of radiation levels.
5. Radiation measurements must be done by independent and trustworthy third party, rather than self-certification by the operators.
6. Base station antenna sites should be prohibited to access by general people. Public should be discourage longer stay in the zone of base station, even for the maintenance personnel.
7. Sign boards or warning signs to be provided at base station / tower sites, must be clearly visible and identifiable. A warning sign should be placed at the entrance of such zones.
8. The service provider will be liable for penal action, if the guidelines are violated.

Cumulative effect of electromagnetic radiation: what next?

Actually wireless technologies are not environmental-friendly, even it utilize about 10 times more power than wired technologies (Baliga *et al.* 2011). Mobile phone is now one of the booming industry and its usage increasing day by day among people with addiction and without considering darker side of this technology. More numbers of Mobile phone towers and amplifiers are added day by day worldwide considering havoc demand.

We are exposing continuously to uninterrupted radiation comes from different appliances like mobile phones and towers, microwave ovens, Laptops, FM radio towers etc. These all are working together. Therefore, policy makers should be active enough to form strict radiation norms. Researchers, industrial people,

entrepreneurs have to come out immediately with effective solutions, which may be costly but never greater than the risk that is faced by human, animals, birds and environment (Ghosh *et al*. 2017). Proposal already initiated regarding placing of heterogeneous networks of cells at indoor level with faster connectivity, lower radiation and low power utilization as some effective alternative to present mobile phone tower system (Saravanamuttu *et al.* 2016).

More consciousness about health, reduction of time of use of cell phones within permissible limit, use of mobile phone as some utility item and not any item for entertainment, prohibition of use of mobile phones by children and pregnant women, arrangement of provisions to reduce radiation and constant research to reduce the harmful effects of that technology may lead us to a better condition in future.

Rajdeep Mitra
Assistant Professor (ECE),
Ideal Institute of Engineering, Kalyani,
Nadia, West Bengal, India.

Shibabrata Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

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